

**State Water Resources Control Board
California Environmental Protection Agency**

-DRAFT-

**Development of Flow Criteria for the Sacramento-San Joaquin Delta
Ecosystem**

Prepared Pursuant to the Sacramento-San Joaquin Delta Reform Act of 2009



July 20, 2010

July 20, 2010 DRAFT Delta Flow Criteria Report

1. Executive Summary

The Sacramento-San Joaquin Delta (Delta) is a critically important natural resource for California and the nation. It is both the hub of California's water supply system and the most valuable estuary and wetlands on the western coast of the Americas. The Delta is in ecological crisis, resulting in high levels of conflict that affect the sustainability of existing water policy in California. Several species of fish have been listed as protected species under the California Endangered Species Act (CESA) and under the federal Endangered Species Act (ESA). These two laws and other regulatory constraints have restricted water diversions from the Delta in an effort to prevent further harm to the protected species.

In November 2009, California enacted a comprehensive package of four policy bills and a bond measure intended to meet California's growing water challenges by adopting a policy of sustainable water supply management to ensure a reliable water supply for the State and to restore the Delta and other ecologically sensitive areas. One of these bills, Senate Bill No. 1 (SB 1) (Stats. 2009 (7th Ex. Sess.) ch 5, § 39) contains the Sacramento-San Joaquin Delta Reform Act of 2009 (Delta Reform Act), Water Code section 85000 et seq. The Delta Reform Act establishes a Delta Stewardship Council (Council), tasked with developing a comprehensive, long-term management plan for the Delta, known as the Delta Plan, and providing direction to multiple state and local agencies that take actions related to the Delta. The comprehensive bill package also sets water conservation policy, requires increased groundwater monitoring, and provides for increased enforcement against illegal water diversions.

The Delta Reform Act requires the State Water Board to use a public process to develop new flow criteria for the Delta ecosystem. During this process, participants cautioned the the State Water Board on the limitations of any flow criteria (Fleenor *et al.*, 2010):

"How much water do fish need?" has been a common refrain in Delta water management for many years... it is highly unlikely that any fixed or predetermined prescription will be a "silver bullet". The performance of native and desirable fish populations in the Delta requires much more than fresh water flows. Fish need enough water of appropriate quality over the temporal and spatial extent of habitats to which they adapted their life history strategies. Typically, this requires habitat having a particular range of physical characteristics, appropriate variability, adequate food supply and a diminished set of invasive species. While folks ask "How much water do fish need?" they might well also ask, "How much habitat of different types and locations, suitable water quality, improved food supply and fewer invasive species that is maintained by better governance institutions, competent implementation and directed research do fish need?" The answers to these questions are interdependent. We cannot know all of this now, perhaps ever, but we do know things that should help us move in a better direction, especially the urgency for being proactive. We do know that current policies have been disastrous for desirable fish. It took over a century to change the Delta's ecosystem to a less desirable state; it will take many decades to put it back together again with a different physical, biological, economic, and institutional environment."

The State Water Board concurs with this cautionary note.

1.1 Legislative Directive and State Water Board Approach

Legislative Directive

Water Code section 85086, contained in the Delta Reform Act, was enacted as part of the comprehensive package of water legislation adopted in November 2009. Water Code section 85086 requires the State Water Resources Control Board (State Water Board) to use the best available scientific information gathered as part of a public process conducted as an informational proceeding to develop new flow criteria for the Delta ecosystem to protect public trust resources. The purpose of the flow criteria is to inform planning decisions for the Delta Plan and the BDCP. The Legislature intended to establish an accelerated process to determine the instream flow needs of the Delta in order to facilitate the planning decisions required to meet the objectives of the Delta Plan. Accordingly, Water Code section 85086 requires the State Water Board to develop the flow criteria within nine months of enactment of the statute and to submit its flow criteria determinations to the Council within 30 days of their development.

State Water Board Approach

In determining the extent of protection to be afforded public trust resources through the development of the flow criteria, the State Water Board considered the broad goals of the planning efforts the criteria are intended to inform, including restoring and promoting viable, self-sustaining populations of aquatic species. Given the accelerated time frame in which to develop the criteria, the State Water Board's approach to developing criteria was limited to review of instream needs in the Delta ecosystem, specifically fish species and Delta outflows, while also receiving information on hydrodynamics and major tributary inflows. The State Water Board's flow criteria determinations are accordingly limited to protection of aquatic resources in the Delta.

Limitations of State Water Board Approach

When setting flow objectives with regulatory effect, the State Water Board reviews and considers all the effects of the flow objectives through a broad inquiry into all public trust and public interest concerns. For example, the State Water Board would consider other public trust resources potentially affected by Delta outflow requirements and impose measures for the protection of those resources, such as requiring sufficient water for cold water pool in reservoirs to maintain temperatures in Delta tributaries. The State Water Board would also consider a broad range of public interest matters, including economics, power production, human health and welfare requirements, and the effects of flow measures on non-aquatic resources (such as habitat for terrestrial species). The limited process adopted for this proceeding does not include this comprehensive review.

The State Water Board's Public Trust Responsibilities in this Proceeding

Under the public trust doctrine, the State Water Board must take the public trust into account in the planning and allocation of water resources, and to protect public trust uses whenever feasible. (*National Audubon Society v. Superior Court* (1983) 33 Cal.3d 419, 446.) Public trust values include navigation, commerce, fisheries, recreation, scenic, and ecological values. "[I]n determining whether it is 'feasible' to protect public trust values like fish and wildlife in a particular instance, the [State Water] Board must determine whether protection of those values, or what level of protection, is 'consistent with the public interest.'" (*State Water Resources Control Bd. Cases* (2006) 136 Cal.App.4th 674, 778.) The State Water Board does not make any determination regarding the feasibility of the public trust recommendations and consistency with the public interest in this report.

In this forum, the State Water Board has not considered the allocation of water resources, the application of the public trust to a particular water diversion or use, water supply impacts, or any balancing between potentially competing public trust resources (such as potential adverse effects of increased Delta outflow on the maintenance of coldwater resources for salmonids in upstream areas). Any such application of the State Water Board's public trust responsibilities, including any balancing of public trust values and water rights, would be conducted through an adjudicative or regulatory proceeding. Instead, the State Water Board's focus here is solely on identifying public trust resources in the Delta ecosystem and determining the flow criteria, as directed by Water Code section 85086.

Future Use of This Report

None of the determinations in this report have regulatory or adjudicatory effect. Any process with regulatory or adjudicative effect must take place through the State Water Board's water quality control planning, water rights processes, or public trust proceedings in conformance with applicable law. In the State Water Board's development of Delta flow objectives with regulatory effect, it must ensure the reasonable protection of beneficial uses, which may entail balancing of competing beneficial uses of water, including municipal and industrial uses, agricultural uses, and other environmental uses. The State Water Board's evaluation will include an analysis of the effect of any changed flow objectives on the environment in the watersheds in which Delta flows originate, the Delta, and the areas in which Delta water is used. It will also include an analysis of the economic impacts that result from changed flow objectives.

Nothing in either the Delta Reform Act or in this report amends or otherwise affects the water rights of any person. In carrying out its water right responsibilities, the State Water Board may impose any conditions that in its judgment will best develop, conserve, and utilize in the public interest the water to be appropriated. In making this determination, the State Water Board considers the relative benefit to be derived from all beneficial uses of the water concerned and balances competing interests.

The State Water Board has continuing authority over water right permits and licenses it issues. In the exercise of that authority and duty, the State Water Board may, if appropriate, amend terms and conditions of water right permits and licenses to impose further limitations on the diversion and use of water by the water right holder to protect public trust uses or to meet water quality and flow objectives in Water Quality Control Plans it has adopted. The State Water Board must provide notice to the water permit or license holder and an opportunity for hearing before it may amend a water right permit or license.

If the DWR and/or the USBR in the future request the State Water Board to amend the water right permits for the State Water Project (SWP) and/or the Central Valley Project (CVP) to move the authorized points of diversion for the projects from the southern Delta to the Sacramento River, Water Code section 85086 directs the State Water Board to include in any order approving a change in the point of the diversion of the projects appropriate Delta flow criteria. At that time, the State Water Board will determine appropriate permit terms and conditions. That decision will be informed by the analysis in this report, but will also take many other factors into consideration, including any newly developed scientific information, habitat conditions at the time, and other policies of the State, including the relative benefit to be derived from all beneficial uses of water.

The flow recommendations in this report are not pre-decisional in regard to any State Water Board action. (e.g., Wat. Code, § 85086, subd. (c)(1).)

The water supply costs of the flows identified in this report illustrate to the State Water Board the need for an integrated approach to management of the Delta. Best available science July 20, 2010 DRAFT Delta Flow Criteria Report supports that it is important to directly address the negative effects of other stressors, including habitat, water quality, and invasive species, that contribute to higher demands for water to protect public trust resources. The flow criteria highlight the continued need for the BDCP to develop an integrated set of solutions and to implement non flow measures to protect public trust resources.

1.2 Summary Determinations

This report contains the State Water Board's determinations as to the flows that protect public trust resources in the Delta, under the narrow circumstances analyzed in this report. As required, the report includes the volume, timing, and quality of flow for protection of public trust resources under different hydrologic conditions. The flow criteria represent a technical assessment only of flow and operational requirements that provide fishery protection under existing conditions. The flow criteria contained in this report do not represent flows that might be protective under other conditions. The State Water Board recognizes that changes in existing conditions may alter the need for flow. Changes in existing conditions that may affect flow needs include, but are not limited to, reduced reverse flows in Delta channels, increased tidal habitat, improved water quality, reduced competition from invasive species, changes in the point of diversion of the State Water Project (SWP) and Central Valley Project (CVP), and climate change.

Flow Criteria and Conclusions

The numeric criteria determinations in this report must be considered in the following context:

- ☐ The flow criteria in this report do not consider any balancing of public trust resource protection with public interest needs for water.
- ☐ The State Water Board does not intend that the criteria should supersede requirements for health and safety such as the need to manage water for flood control.
- ☐ There is sufficient scientific information to support the need for increased flows to protect public trust resources; there is uncertainty regarding specific numeric criteria.

The State Water Board has considered the testimony presented during the Board's informational proceeding to develop flow criteria and to support the following summary conclusions. Several of these summary conclusions rely in whole or in part on conclusions and recommendations made to the State Water Board by the Delta Environmental Flows Group¹ and the University of California at Davis Delta Solutions Group².

¹ The Delta Environmental Flows Group of experts consists of William Bennett, Jon Burau, Cliff Dahm, Chris Enright, Fred Feyrer, William Fleenor, Bruce Herbold, Wim Kimmerer, Jay Lund, Peter Moyle, and Matthew Nobriga

² The Delta Solutions Group consists of William Bennett, William Fleenor, Jay Lund, and Peter Moyle

1. The effects of non-flow changes in the Delta ecosystem, such as nutrient composition, channelization, habitat, invasive species, and water quality, need to be addressed and integrated with flow measures.

2. Recent Delta flows are insufficient to support native Delta fishes for today's habitats.³ Flow modification is one of the immediate actions available although the links between flows and fish response are often indirect and are not fully resolved. Flow and physical habitat interact in many ways, but they are not interchangeable.

3. In order to preserve the attributes of a natural variable system to which native fish species are adapted, many of the criteria developed by the State Water Board are crafted as percentages of natural or unimpaired flows. These criteria include:

- ☐ 75% of unimpaired Delta outflow from January through June;
- ☐ 75% of unimpaired Sacramento River inflow from November through June;
- and
- ☐ 60% of unimpaired San Joaquin River inflow from February through June.

It is not the State Water Board's intent that these criteria be interpreted as precise flow requirements for fish under current conditions, but rather they reflect the general timing and magnitude of flows under the narrow circumstances analyzed in this report. In comparison, historic flows over the last 18 to 22 years have been:

- ☐ approximately 30% in drier years to almost 100% of unimpaired flows in wetter years for Delta outflows;
- ☐ about 50% on average from April through June for Sacramento River inflows;
- and
- ☐ approximately 20% in drier years to almost 50% in wetter years for San Joaquin River inflows.

4. Other criteria include: increased fall Delta outflow in wet and above normal years; fall pulse flows on the Sacramento and San Joaquin Rivers; and flow criteria in the Delta to help protect fish from mortality in the central and southern Delta resulting from operations of the State and federal water export facilities.

5. The report also includes determinations regarding: variability and the natural hydrograph, floodplain activation and other habitat improvements, water quality and contaminants, cold water pool management, and adaptive management:

³ This statement should not be construed as a critique of the basis for existing regulatory requirements included in the 2006 Bay-Delta Plan and biological opinions. Those requirements were developed pursuant to specific statutory requirements and considerations that differ from this proceeding. Particularly when developing water quality objectives, the State Water Board must consider many different factors including what constitutes reasonable protection of the beneficial use and economic considerations. In addition, the biological opinions for the SWP and CVP Operations Criteria and Plan were developed to prevent jeopardy to specific fish species listed pursuant to the federal Endangered Species Act; in contrast, the flow criteria developed in this proceeding are intended to halt population decline and increase populations of certain species.

- ☐ Criteria should reflect the frequency, duration, timing, and rate of change of flows, and not just volumes or magnitudes. Accordingly, whenever possible, the criteria specified above are expressed as a percentage of the unimpaired hydrograph.
- ☐ Inflows should generally be provided from tributaries to the Delta watershed in proportion to their contribution to unimpaired flow unless otherwise indicated.
- ☐ Studies and demonstration projects for, and implementation of, floodplain restoration, improved connectivity and passage, and other habitat improvements should proceed to provide additional protection of public trust uses and potentially allow for the reduction of flows otherwise needed to protect public trust resources in the Delta.
- ☐ The Central Valley and San Francisco Regional Water Quality Control Boards should continue developing Total Maximum Daily Loads (TMDLs) for all listed pollutants and adopting programs to implement control actions.
- ☐ The Central Valley Regional Water Quality Control Board should require additional studies and incorporate discharge limits and other controls into permits, as appropriate, for the control of nutrients and ammonia.
- ☐ Temperature and water supply modeling and analyses should be conducted to identify conflicting requirements to achieve both flow and cold water temperature goals.
- ☐ A strong science program and a flexible management regime are critical to improving flow criteria. The State Water Board should work with the Council, the Delta Science Program, BDCP, the Interagency Ecological Program, and others to develop the framework for adaptive management that could be relied upon for the management and regulation of Delta flows.
- ☐ The numeric criteria recommended in this report are all recommendations that are only appropriate for the current physical system and climate; as other factors change the flow needs advanced in this report will also change. As physical changes occur to the environment and our understanding of species needs improves, the long-term flow needs will also change. Actual flows should be informed by adaptive management.
- ☐ Only the underlying principles for the numeric criteria and other measures are advanced as long term recommendations.

6. Past changes in the Delta may influence migratory cues for some fishes. These cues are further scrambled by a reverse salinity gradient in the south Delta. It is important to establish seaward gradients and create more slough networks with natural channel geometry. Achieving a variable more complex estuary requires establishing seasonal gradients in salinity and other water quality variables and diverse habitats throughout the estuary. These goals in turn encourage policies which establish internal Delta flows that create a tidally-mixed upstream- downstream gradient (without cross-Delta flows) in water quality. Continued through-Delta conveyance is likely to continue the need for in-Delta flow requirements and restrictions to protect fish within the Delta.

7. Restoring environmental variability in the Delta is fundamentally inconsistent with

continuing to move large volumes of water through the Delta for export. The drinking and agricultural water quality requirements of through-Delta exports, and perhaps even some current in-Delta uses, are at odds with the water quality and variability needs of desirable Delta species.

8. The Delta ecosystem is likely to dramatically shift within 50 years due to large scale levee collapse. Overall, these changes are likely to promote a more variable, heterogeneous estuary. This changed environment is likely to be better for desirable estuarine species; at least it is unlikely to be worse.

9. Positive changes in the Delta ecosystem resulting from improved flow or flow patterns will benefit humans as well as fish and wildlife.

Ecosystems are complex; there are many factors that affect the quality of the habitat that they provide. These factors combine in ways that can amplify the effect of the factors on aquatic resources. The habitat value of the Delta ecosystem for favorable species can be improved by habitat restoration, contaminant and nutrient reduction, changes in diversions, control of invasive species, and island flooding. Each of these non-flow factors has the potential to interact with flow to affect available aquatic habitat in Delta channels.

The State Water Board supports the most efficient use of water that can reasonably be made. The flow improvements that the State Water Board identifies in this report as being necessary to protect public trust resources illustrate the importance of addressing the negative effects of these other stressors that contribute to higher than necessary demands for water to provide resource protection. Future habitat improvements or changes in nutrients and contaminants, for example, may change the response of fishes to flow. Addressing other stressors directly will be necessary to assure protection of public trust resources and could change the demands for water to provide resource protection in the future. Uncertainty regarding the effects of habitat improvement and other stressors on flow demands for resource protection highlights the need for continued study and adaptive management to respond to changing conditions.

The flow criteria identified in this report highlight the need for the BDCP to develop an integrated set of solutions, to address ecosystem flow needs, including flow and non-flow measures.

Although flow modification is an action that can be implemented in a relatively short time in order to improve the survival of desirable species and protect public trust resources, public trust resource protection cannot be achieved solely through flows – habitat restoration also is needed. One cannot substitute for the other; both flow improvements and habitat restoration are essential to protecting public trust resources.

1.3 Background and Next Steps

Informational Proceeding

The State Water Board held an informational proceeding on March 22, 23, and 24, 2010, to receive scientific information from technical experts on the Delta outflows needed to protect public trust resources. The State Water Board also received information at the proceeding on flow criteria for inflow to the Delta from the Sacramento and San Joaquin

rivers and Delta hydrodynamics. The State Water Board did not solicit information on the need for water for other beneficial uses, including the amount of water needed for human health and safety, during the informational proceeding. Nor did the State Water Board consider other policy considerations, such as the state goal of providing a decent home and suitable living environment for every Californian.

Analytical Methods

The State Water Board received a wide range of recommendations for the volume, quantity and timing of flow necessary to protect public trust resources. Recommendations were also received on non-flow related measures. State Water Board determinations of flow criteria rely upon four types of information:

- ☐ Unimpaired flows
- ☐ Historical impaired inflows that supported more desirable ecological conditions
- ☐ Statistical relationships between flow and native species abundance
- ☐ Ecological functions-based analysis for desirable species and ecosystem attributes

The State Water Board emphasizes, however, information based on ecological functions, followed by information on statistical relationships between flow and native species abundance.

In all cases, the flow criteria contained in this report are those supported by the best available scientific information submitted into the record for this proceeding. The conceptual bases for all of the criteria in this report are supported by scientific information on function-based species or ecosystem needs. In other words, there is sufficiently strong scientific evidence to support the need for flows necessary to support particular functions. This does not necessarily mean that there is scientific evidence to support *specific* numeric criteria. Criteria are therefore divided into two categories: Category "A" criteria have more and better scientific information, with less uncertainty, to support specific numeric criteria than do Category "B" criteria. The State Water Board followed the following steps to develop flow criteria and other measures:

1. Establish general goals and objectives for protection of public trust resources in the Delta
2. Identify species to include based on ecological, recreational, or commercial importance.
3. Review and summarize species life history requirements
4. Summarize numeric and other criteria for each of: Delta outflow, Sacramento River inflow, San Joaquin River inflow, and Hydrodynamics, including Old and Middle River flows
5. Review other flow-related and non-flow measures that should be considered
6. Provide summary determinations for flow criteria and other measures

In developing its flow criteria, the State Water Board reviewed the life history requirements of the following pelagic and anadromous species:

- ☐ Chinook Salmon (various runs)
- ☐ American Shad.

- ☐ Longfin Smelt
- ☐ Delta Smelt
- ☐ Sacramento Splittail
- ☐ Starry Flounder
- ☐ Bay Shrimp
- ☐ Zooplankton

The flow criteria needed to protect public trust resources are more than just the sum of each species-specific flow need. The State Water Board also considered the following issues to make its flow criteria determinations:

- ☐ Variability, flow paths, and the natural hydrograph
- ☐ Floodplain activation and other habitat improvements
- ☐ Water quality and contaminants
- ☐ Cold water pool management
- ☐ Adaptive management

The Board also made other specific determinations for other measures based on review of these issues.

Regulatory Authority of the State Water Board

The State Water Board was established in 1967 as the State agency with jurisdiction to administer California's water resources. The State Water Board is responsible for water allocation as well as for water quality planning and water pollution control. In carrying out its water quality planning functions under both State and federal law, the State Water Board formulates and adopts state policy for water quality control, which includes water quality principles and guidelines for long-range resource planning, water quality objectives, and other principles and guidelines deemed essential by the State Water Board for water quality control. The State Water Board has adopted a Water Quality Control Plan for the Delta (Bay-Delta Plan). The plan is implemented in part through conditions imposed in both water quality and water right permits.

The State Water Board administers the water rights program for the State, including issuing water right permits. More than two-thirds of the residents of California and more than two million acres of highly productive farmlands receive water exported from the Delta, primarily, although not exclusively, through the SWP and CVP. In addition to the SWP and CVP, there are many other diversions from the Delta and from tributaries to the Delta including the East Bay Municipal Utilities District, the San Francisco Public Utilities Commission, and Contra Costa Water District, to name a few.

Regulatory actions by other agencies

In addition to the State Water Board, other state and federal agencies have authority to take regulatory action that can affect Delta inflows, outflows, and hydrodynamics. As indicated below, the United States Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), and the California Department of Fish and Game

(DFG) have authority to impose regulatory conditions that affect water diversions from the Delta. The Federal Energy Regulatory Commission (FERC) also has authority over non-federal hydropower projects that can change the timing and quantity of inflows to the Delta. Over the next six years, there are 16 hydropower projects on tributaries to the Sacramento and San Joaquin rivers with potential to affect Delta tributary flows that have ongoing or pending proceedings before the FERC.

Next Steps

The State Water Board will submit its flow criteria determinations to the Council for its information within 30 days of completing its determinations as required by Water Code section 85086.

The flow criteria contained in this report will be submitted to the Council to inform the Delta Plan. The Council is required to develop the Delta Plan to implement the State's co-equal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The Council is to develop the Delta Plan by January 2012.

The flow criteria will also inform the BDCP. The BDCP is a multispecies conservation plan being developed pursuant to the ESA and the State Natural Community Conservation Planning Act (NCCPA), administered by the USFWS and the NMFS and the DFG, respectively. The CESA and the federal ESA generally prohibit the "take" of species protected pursuant to the acts. Both acts contain provisions that allow entities to seek approvals from the resources agencies, which approvals allow limited take of protected species under some circumstances. The BDCP is intended to meet all regulatory requirements necessary for USFWS and NMFS to issue Incidental Take Permits to allow incidental take of all proposed covered species as a result of covered activities undertaken by DWR, certain SWP contractors, and Mirant Corporation, and to issue biological opinions under the ESA to authorize incidental take for covered actions undertaken by USBR and CVP contractors. The BDCP is also intended to address all of the requirements of the NCCPA for aquatic, wetland, and terrestrial covered species of fish, wildlife, and plants and Delta natural communities affected by BDCP actions and is intended to provide sufficient information for DFG to issue permits under the CESA for the taking of the species proposed for coverage under the BDCP.

Finally, the flow criteria in this report will also inform the State Water Board's on-going and subsequent proceedings, including the review and development of flow objectives in the San Joaquin River, a comprehensive update to the Bay-Delta Plan, and the associated water rights proceedings to implement these Bay-Delta Plan updates.